Atmospheric Heat, Dust, and Water Transport During Martian Polar Warmings

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How the Martian atmosphere transports heat, dust, and water into the polar air column is likely to affect the development of the polar layered terrains, growth of the seasonal polar caps, optical properties of the polar caps, and partitioning of CO2 condensation between the atmosphere and surface. It has been known for some time that the vigour of the large scale circulation and transport into the polar air mass are related to the amount of dust suspended in the atmosphere. During periods of low dust loading, the Hadley circulation terminates well short of the polar regions and a strong, isolating polar jet vortex develops along the polar front. When dust increases, the Hadley cell expands and eddy transports increase. However, until recently it has not proven possible to simulate the most dramatic episode in observed polar meteorology: the polar warming following the second global dust storm of 1977. Model improvements have now allowed simulation of this event in the NASA Ames GCM (Haberle et al. 1996 - companion abstract).

The ability of the Ames GCM to emulate the observed polar warming increases confidence in the fidelity of the model during periods of high dust loading. We will present analysis of model output for varying dust loading configurations. In particular we will illustrate variations in the heat transport associated with the mean circulation, and stationary and transient eddies; variations in the amount and location of atmospheric condensation; and the results of tracer transport studies using an aerosol model coupled to the GCM. We will also examine the simulated 1977 polar warming in order to compare with the Viking observations of atmospheric temperature and dust transport.

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